

Biology and Ecology of Oriental Termites (Isoptera)

No. 4.* The Dry-wood Termite, *Coptotermes heimi* (Wasm.), in India.

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(With 3 Plates)

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I. INTRODUCTION

Coptotermes heimi (Wasmann) (synonym : *C. parvulus* Holmgren) (Fam. Rhinotermitidae, Subfam. Coptotermitinae) is one of the three species of termites which are most destructive to timber in houses and elsewhere in India, the other two species being *Heterotermes indicola* (Wasmann) and *Odontotermes feae* (Wasmann).

It is interesting to note that although *Coptotermes heimi* is a species occurring commonly throughout the Indian region, it is not (except in Lahore, West Pakistan) the common species to be found attacking the experimental pieces of timber buried in the ground (*vide* Beeson, 1934, p. 3). Beeson stated that the species occurring in the experimental wood-cubes treated with wood-preservedatives and buried in the ground in Lahore was *C. heimi*, but in corresponding tests done elsewhere in India and

*Earlier numbers are as follows:

- No. 1. *JBNHS* (1954), 52 (2 & 3): 459-462, 1 pl.
- No. 2. *ibid.*, (1954), 52 (2 & 3): 463-467, 1 pl.
- No. 3. *ibid.*, (1955), 53 (2): 234-239, 2 pls.

Ceylon the species were different, thus: at Pusa (Bihar), *Microtermes obesi* Holmg. [= *M. anandi* Holmg.]; at Calcutta, *Odontotermes feae* (Wasm.); at Bangalore (S. India), *O. horni* (Wasm.); at Dehra Dun (U.P.), *O. bangalorensis* Holmg.; and in Ceylon, *O. horni* (Wasm.), *O. (Hypotermes) obscuriceps* (Wasm.), *O. redemanni* (Wasm.), and *Coptotermes ceylonicus* Wasm.

Information on the biology of *Coptotermes heimi* is limited and widely scattered. Some new information on its biology is presented here, and the existing knowledge summarised for easy reference.

In the course of a systematic revision of the Indian species of genus *Coptotermes* Wasmann, a large amount of material, consisting of over 63 lots and nearly 150 separate vials, was examined from all over India (including a few from the western Punjab, in West Pakistan). This material contained the original data of the collectors relating to dates and time of swarming, the names of the hosts attacked, and other valuable information on the biology of the species. The data are summarised below. Some of these specimens, e.g. from Calcutta, Kharagpur, and Allahabad, collected during 1907-1910, bore previous but wrong determination labels as *Coptotermes travians* (Haviland), and it is likely that they may have been referred to in the literature under that name. Besides this material, some data on nests became available during recent field surveys, and from other sources.

The data discussed here concern the following particulars: Geographical distribution; host-material; nature of damage; swarming; nests; duration of life; etc. The limited information available in the published literature on the species has also been discussed. Authors in whose papers information on biology and ecology is available are the following:

Annandale (1923): Swarming; nest construction, etc.

Assmuth (1913): Nature of damage to wood; nest-structure; swarming. (Accounts of *C. heimi* and *C. parvulus* were mixed up and not mentioned separately; most of the remarks refer to '*Coptotermes*'.)

Beeson (1934): Nature of damage.

Beeson (1941): Summary of biology.

Holmgren, K. & Holmgren, N. (1917): Swarming.

Holmgren, N. (1912): Swarming.

Margabandhu (1934): Summary of known information.

Rattan Lal & Menon (1953): Literature on biology and systematics. [Mixed with *C. travians* (Haviland), with which they synonymise *C. heimi* (Wasm.)]

Roonwal (1954): Ecology.

Besides these, Assmuth (1915), Silvestri (1923), Dover (1931), and Dover & Mathur (1934) make casual mention of *C. heimi*.

The nomenclative position of the species is summarised below:

Coptotermes heimi (Wasmann, 1902)(Synonym: *Coptotermes parvulus* Holmgren, 1913)

1902. *Arrhinotermes heimi* Wasmann, *Zool. Jb. (Syst.)*, Jena, 17 (1), p. 104, Pl. 4, Fig. 1. (India: Wallon, Ahmadnagar Dist., Bombay State).
1911. *Coptotermes heimi*, N. Holmgren, *K. Sv. Vet. Akad. Handl.*, Stockholm, 46 (6), p. 73.
1913. *Coptotermes parvulus* N. Holmgren, *J. Bombay nat. Hist. Soc.*, Bombay, 22 (1), p. 104; and *K. Sv. Vet. Akad. Handl.*, Stockholm, 50 (2), p. 73. (In both cases: Anand and Vadtal, Bombay State.)
1953. *Coptotermes travians* (Havil.), Rattanlal & Menon, *Catal. Indian Ins.*, No. 27, *Isoptera*, Delhi, p. 27. (Erroneously synonymise *C. heimi* (Wasmann) with *C. travians* Haviland.)
- Bugnion (1910, *Ann. Soc. Ent. Fr.*, Paris, 79, p. 137) also wrongly determined *C. heimi* specimens as *C. travians*.

Where no source is mentioned, the data given in the following account are original.

I am indebted to Shri M. Srinivasan, Curator, Industrial Section, Botanical Survey of India, Calcutta, for kindly checking the correct botanical names of the host-plants.

II. GEOGRAPHICAL DISTRIBUTION

Coptotermes heimi occurs all over India and parts of West Pakistan (Punjab). The present material studied by me is from the following localities:

INDIA

Andhra Pradesh: Adoni.

Assam: Gauhati.

Bihar: Ankura (Saranda Div.); Pusa.

Bombay State: Bombay city and environs.

Madhya Pradesh: Khandwa; Sillari (near Nagpur); Balaghat.

Mysore State: Dharwar; Sidapur (Coorg); Bellahunisi, Kottur; Siriguppa.

Orissa: Barkuda Is. (Chilka Lake); Angul; Sambalpur; Balukhand (Puri Dist.).

Punjab: Hoshiarpur; Sri Hargobindapur (Gurdaspur Dist.); Jullander.

Rajasthan: Bariganga near Jodhpur.

Uttar Pradesh: Dehra Dun and vicinity (alt. ca. 610 m.); Kalsi (Dehra Dun Dist.); Chakrata (alt. ca. 2100 m.); Kanpur; Allahabad; Mirzapur; Rampur; Gopalnagar (Bijnor Dist.); Pathargarh (Najibabad Dist.); Lucknow; Biharigarh (Saharanpur Dist.); Haldwani.

West Bengal: Calcutta and environs; the 24-Parganas (the Sundarbans); Bankura; Kharagpur; Sam Sing.

WEST PAKISTAN

W. Punjab: Chichawatni; Lahore.

'*C. parvulus* Holmg.' has been recorded from India and West Pakistan as follows:

Anand and Vadtal in Bombay State. (type localities.) (Holmgren, 1913 *a, b*.)

Barkuda Is. (Chilka Lake, Orissa.) (Annandale, 1923; Silvestri, 1923.)

Karachi (Sind, W. Pakistan). (Assmuth, 1913.)

III. HOST-MATERIAL, ETC.

Coptotermes heimi appears to be polyphagous and occurs in dead wood and under bark of numerous host-plants as well as in constructional timber in houses, railway coaches, bobbins, packing cases, old sleepers, and in insulated electric wire. It has also been recorded from 'mud tunnels' (apparently cemented excreta tunnels) on walls, and in one case 'ex mound' (Angul, Orissa) but it is not clear whether the mound was built by the *Coptotermes* itself or by some other species—species of *Coptotermes* are not known to be mound-builders in India, though an Australian species, *C. lacteus* (Frogg.), does build mounds. In another case it was recorded 'ex nest in a tree', and here again it is not clear whether it was a nest of the *Coptotermes* itself or of some other termite or even an ant.

1. List of Host-plants

About 35 different species, belonging to a wide assortment of families, have been recorded as hosts, as follows:

Acacia arabica Willd., Babul, Fam. Leguminosae. (From rotten log).

Acacia sp., Fam. Leguminosae. (From dead plant).

Albizzia sp., Fam. Leguminosae. (Under bark).

Avicennia sp. (*A. alba* Linn. or *A. officinalis* Linn.), Baen, Fam. Verbenaceae. (Nest found in dead log).

Bamboo, Fam. Gramineae, Tribe Bambuseae. (From dry splints).

Bauhinia vahlii W. & A., Fam. Leguminosae. (From dead log).

Boswellia serrata Roxb., Salai, Fam. Burseraceae.

Cactus sp., Fam. Cactaceae.

Carica papaya Linn., Papaya, papita, Fam. Caricaceae.

Casuarina equisetifolia Forst., Fam. Casuarinaceae. (Under bark).

Cedrela toona Roxb., Toon, Fam. Meliaceae. (From dead portion of green standing tree; and dead stump).

Euphorbia nivulia Ham., Thor, Fam. Euphorbiaceae.

- Excaecaria agallocha* Linn., Fam. Euphorbiaceae. (From pole).
- Ficus benghalensis* Linn., Banyan, Fam. Urticaceae (Moraceae according to some authors). (From dead stump. Nests also found in dead trunks).
- Garuga pinnata* Roxb., Fam. Burseraceae.
- Heritiera fomes* Buch.-Ham. (synonym: *H. minor* Roxb.), Sundri, Fam. Sterculiaceae. (From pole).
- Jatropha curcas* Linn., Fam. Euphorbiaceae.
- Lagerstroemia parviflora* Roxb., Fam. Lythraceae. (From half-dead tree).
- Lannea coromandelica* (Houtt.) Merr. [synonyms: *Lannea grandis* (Dennst.) Engl. and *Odina wodier* Roxb.], Fam. Anacardiaceae. (From pole in soil).
- Mangifera indica* Linn., Mango, Fam. Anacardiaceae. (From rotten stump; roots; and under bark).
- Moringa pterygosperma* Gaertn. [synonym: *M. oleifera* Lamk.], Fam. Moringaceae.
- Morus alba* Linn., White mulberry, Fam. Moraceae. (From fallen logs).
- Palm leaves, Fam. Palmae.
- Pinus longifolia* Roxb., Chir Pine, Fam. Pinaceae. (Sometimes wrongly referred to as *P. roxburghii* Sarg.).
- Prunus persica* Bth. & Hook., Peach, Fam. Rosaceae.
- Pterocymbium tinctorium* Merr. [synonym: *Heritiera tinctoria* Blanco], Fam. Sterculiaceae.
- Rhizophora conjugata* Linn., Fam. Rhizophoraceae. (From rafters).
- Salmalia malabarica* Schott & Endl. [synonym: *Bombax malabaricum* DC.], Simal, Silk Cotton tree, Fam. Malvaceae.
- Shorea robusta* Gaertn. f., Sal, Fam. Dipterocarpaceae. (From pole; and under bark).
- Saccharum officinarum* Linn., Sugarcane, Fam. Gramineae. (From stump and crushed pieces).
- Swietenia floribunda* Griff., Fam. Meliaceae.
- Tamarindus indica* Linn., Imli, Fam. Leguminosae. (From stump; and packing case).
- Tamarix gallica* Linn., Fam. Tamaricaceae.
- Tectona grandis* Linn., Teak, Fam. Verbenaceae. (From dead portion of green standing tree; and log).
- Xylocarpus gangeticus* Parkin. [synonym: *Carapa moluccensis* var. *gangeticus* Prain], Fam. Meliaceae. (From pole).

2. Other Material

Besides the host-plants listed above, *C. heimi* has also been recorded as infesting the following materials:

Paper and books; wood-work in houses; wooden packing cases; wooden floor; wooden barrels; chemically treated wood blocks ('grave-yard cubes'); pipe line and wood casing containing electrical wire; insulated electric wire; old wooden sleepers; wood-work of railway coaches; 'feeding on bobbin having cotton thread'; and below cow dung.

IV. ECONOMIC IMPORTANCE AND NATURE OF DAMAGE

As stated above, *Coptotermes heimi* is economically one of the three most important termites which infest the wood-work of buildings in India. Apart from buildings, it attacks wood-work in railway coaches, wooden packing cases, stored timber, wooden sleepers, and papers and books. There are records of it having been taken from 'insulated electric wire' and 'pipe line and wood casing containing electric wire', this damage sometimes leading to the leakage of electric current.

The 'feeding pattern' is characteristic (Pl. 1, fig. 1). The termite eats away the softer parts of the wood along the fibres, leaving the outer surfaces of constructional timber intact. The harder parts of the wood, such as the heartwood, knots, etc., are generally not destroyed, but may be tunnelled through when necessary. Thus, longish, narrow oval cells are constructed whose long axis is along the similar axis of the wood-fibres. The thin partition walls are plastered with excrement. The cavities so formed are filled with a tough, mottled brown to bluish-black deposit (Pl. 1, fig. 2), the so-called 'fillings' of Assmuth (1913), 'formed in an irregular spongy or stringy network resembling superficially fungus combs' of certain termites (Beeson, 1941, p. 543). Assmuth (1913) believed that such plastering was done on all surfaces, including the surfaces of glass bottles, in order to facilitate walking. According to Annandale (1923), however, the plastering with excrement, which is done by the workers during nest-construction also, is for the strengthening of the thin partition walls.

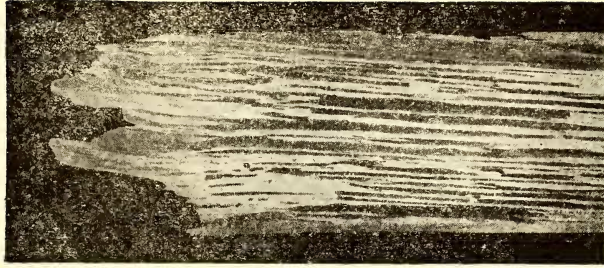
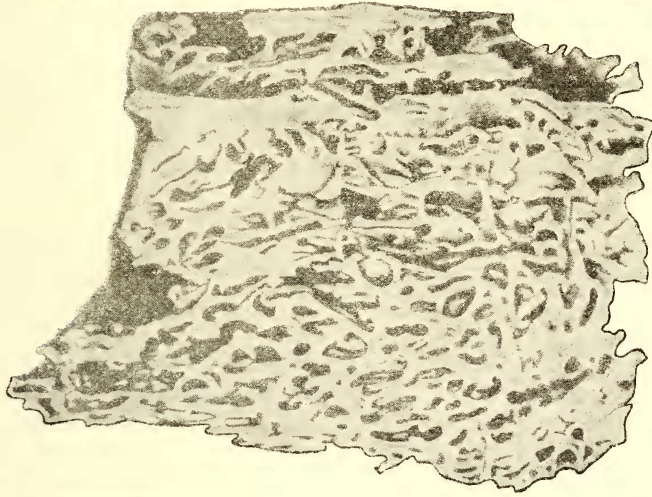
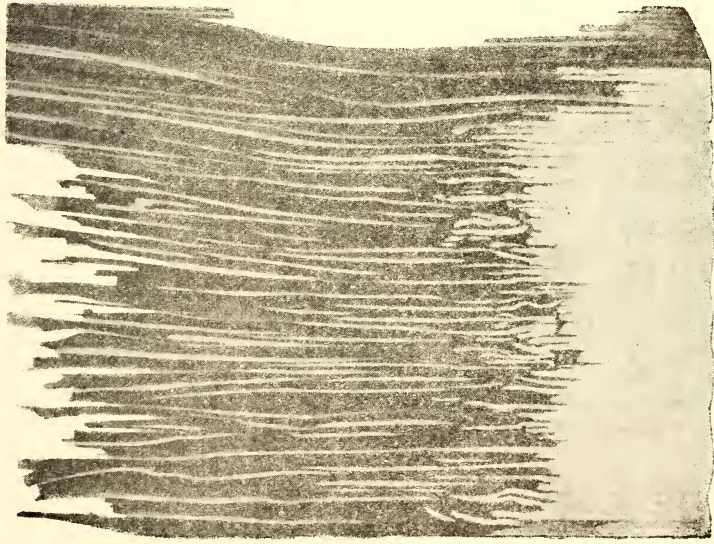
A similar feeding pattern occurs in *Heterotermes indicola* (Wasm.), another important dry-wood termite of India (Pl. 1, fig. 3).

V. SWARMING

Swarming of *Coptotermes heimi* was observed in India in Uttar Pradesh (various parts), West Bengal (Calcutta), Orissa (Barkuda Is., Chilka Lake), and Bombay city.

1. Season of swarming

The following are the recorded dates, years, and locality of swarming, arranged chronologically under each month:



1

2

3

The pattern of damage to wood caused by *Coptotermes heimi* (Wasm.) and *Heterotermes indicola* (Wasm.).
Fig. 1.—A piece of softwood (chir pine) damaged by *Coptotermes heimi*. Enlarged.
Fig. 2.—The 'fillings' which fill the cavities in the wood damaged by *Coptotermes heimi*. Enlarged.
Fig. 3.—A piece of softwood (chir pine) damaged by *Heterotermes indicola* (Wasm.)

'January to March'

Beeson (1941, p. 544) stated: '*C. heimi* swarms at sunset during the dry season and especially in January to March.' This statement needs confirmation with regard to January.

February

2. ii. 1912. Coimbatore.

March

6. iii. 1910. Calcutta.
7. iii. 1908. Calcutta.
15. iii. 1911. Bombay. (Same material as in Holmgren, 1912, pp. 777-778.)
20. iii. 1910. Calcutta.

April

No record.

May

13. v. 1923. Barkuda Is. (Chilka Lake, Orissa).
25. v. 1907. Kharagpur (West Bengal).

June

8. vi. 1911. Pusa (Bihar). (Holmgren & Holmgren, 1917, pp. 144-145.)
11. vi. 1955. Dehra Dun (U.P.), alt. *ca.* 610 m.
12. vi. 1950. —do.—
15. vi. 1953. —do.—
16. vi. 1950. —do.—
19. vi. 1940. —do.—
21. vi. 1955. —do.—

July

1. vii. 1907. Allahabad (U.P.).
3. vii. 1941. Dehra Dun and Kanpur (U.P.).
5. vii. 1955. Dehra Dun (U.P.).
6. vii. 1952. Kalsi (Dehra Dun Dist., U.P.), alt. *ca.* 800 m.
15. vii. 1935. Dehra Dun (U.P.), alt. *ca.* 610 m.

August

6. viii. 1930. Dehra Dun (U.P.), (Only one imago collected.)

From these data it appears that swarming generally occurs from early March to early August. It seems to happen in the spring and early summer (March-May) in the warm and more humid parts of the country

(West Bengal, Orissa, Bombay), and during the monsoon (June to August) in the drier parts (Uttar Pradesh). There is no record of swarming in April. Beeson's (1941, p. 544) general statement of swarming in the winter, 'January to March', needs confirmation; Beeson does not mention the localities.

From his observations on the Barkuda Island (Chilka Lake, Orissa) during 1920-22, Annandale (1923, p. 234) stated as follows :

'Swarms earlier in the dry season [i.e. earlier than June 20]. Winged adults and a female which had just cast its wings were found in a nest on April 29th in 1922.'

He further wrote :

'The communities are comparatively small, only a few winged adults are produced at a time, and they probably issue forth singly or in small parties.'

2. Time of swarming

Swarming was observed at various times, e.g. in the evening, and at 7.30 p.m., 8 p.m., and 10 p.m. Other records merely stated : 'At dusk', 'in light trap,' or 'caught by lamplight'. It would thus appear that swarming occurs at and after dusk in the early part of the night.

3. Other particulars

C. heimi apparently breeds in dead wood of a number of species, below as well as above the ground, as the following records would indicate, and winged adults may thus swarm out of holes in the ground, from logs lying on the ground or from dead standing trees and stumps.

Dehra Dun (U.P.) :

'Adults coming out of a hole in a ground near a pole of *Lannea grandis* Engl.*; soldiers from the pole'.

'Swarming out of a small dead portion of a green standing tree, at about 7.30 p.m.'

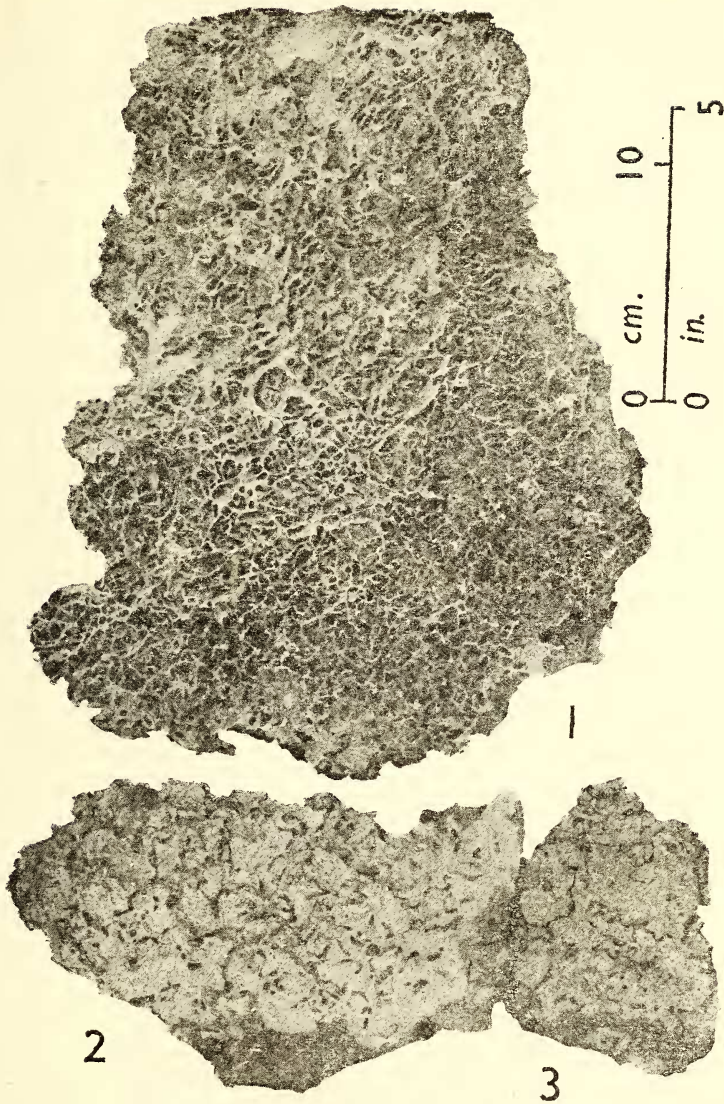
'Swarming out of a dead stump of *Cedrela toona* Roxb. tree.'

'Swarming out of a dead portion of a green standing *Tectona grandis* Linn.'

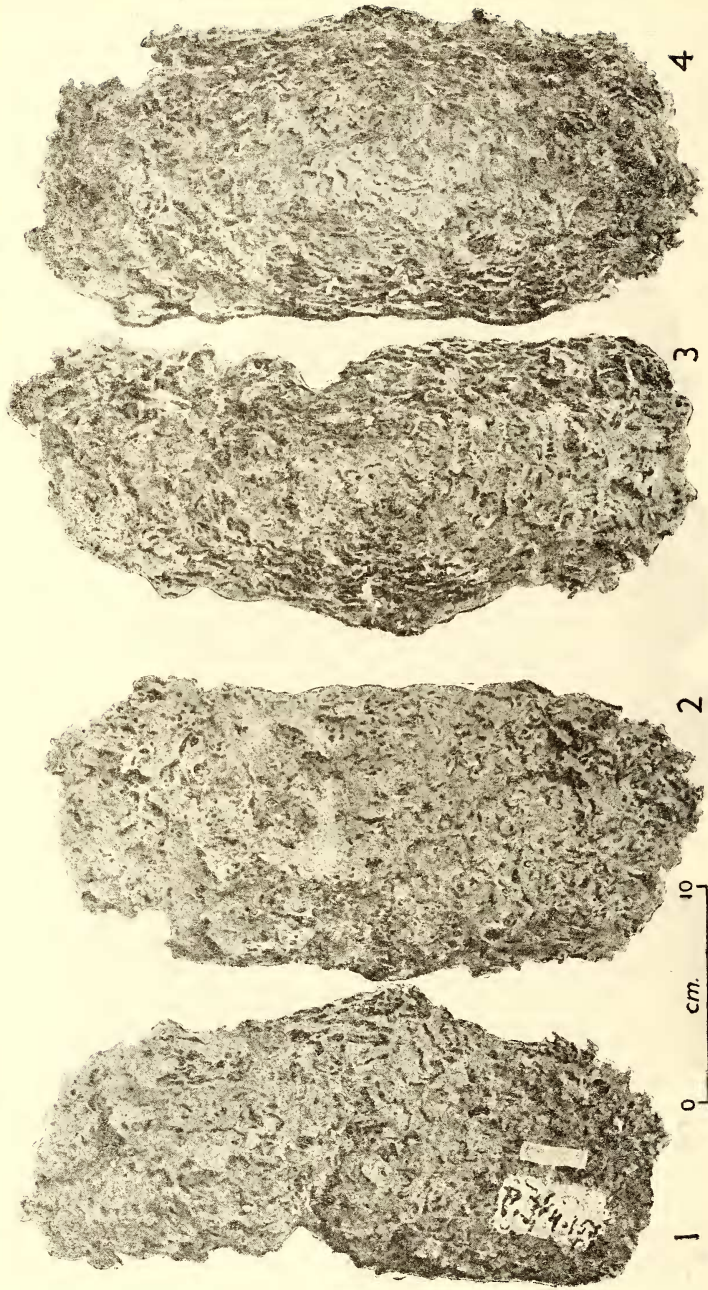
Winged adults 'Ex rotten mango stump'.

One observation, as follows, indicates that swarming may occur even during a light shower of rain :—Barkuda Is. (Chilka Lake, Orissa), 13. v. 1923 : 'At light during slight shower of rain'.

*The current name is *Lannea coromandelica* (Houtt.) Merr. [synonyms: *L. grandis* (Dennst.) Engl. and *Odina wodier* Roxb.]



Nest of the termite *Coptotermes heimi* (Wasmann), found between wooden boards in a railway carriage in north-western India.
Figs. 1, 2, 3. Portions of the nest.



Nest of the termite *Coptotermes heini* (Wasmann), from the Sundarbans, 24-Parganas District, West Bengal, India (Narayanpur village, Namkhana Forest Range, Sundarbans Forest Division), found in a log of the 'baen' tree, *Avicennia* sp. (Family Verbenaceae), lying on the ground. *M. L. Roonwal* coll., 4th January 1954. (Coll. No. R3/4-1-54)

Figs. 1 and 2. Outer view of the nest which has been cut in two halves.

Figs. 3 and 4. Ditto. Inner view of the same two pieces of the nest.

VI. NESTS AND THEIR STRUCTURES

(Plates 2 and 3)

Coptotermes heimi nests in dead logs of wood (Annandale, 1923, pp. 250-251; and Roonwal, present account), as well as in the soil (Beeson, 1941, p. 544). A nest has also been found between the wooden boards of a railway carriage in north-western India (Pl. 2). Either nests or swarming (*vide* above) of winged adults (which indicates breeding) have been recorded from logs or dead standing trees of the following species :

Avicennia sp.—Nest found (*vide infra*).

Cedrela toona Roxb.—Swarming from dead stump.

Ficus benghalensis Linn.—Nests in dead trunks (Annandale, 1923).

Lansea coromandelica (Houtt.) Merr. [synonyms : *L. grandis* (Dennst.) Engl. and *Odina wodier* Roxb.].—Probably nesting. (Swarming from hole in ground near pole of *Lansea*; soldiers taken from the pole).

Mangifera indica Linn.—Swarming from rotten mango stump.

Tectona grandis Linn.—Swarming from dead portion of green standing tree.

Annandale (1923, Pl. V, figs. 5 and 5a) reproduced photographs of small portions of a nest collected in the Barkuda Island (Chilka Lake, Orissa). I reproduce here photographs of two complete nests : (i) A nest found between the wooden boards of a railway carriage in north-western India (Pl. 2), (ii) A nest found in a dead log of 'baen' tree, *Avicennia* sp. (Fam. Verbenaceae) found on the ground in the Sundarbans, West Bengal (Pl. 3).

The nest usually consists of a somewhat flattened, porous structure of dark grey-brown colour, and composed of a network of strands, probably made partly of the harder wood-fibres left over during the process of eating away the wood and partly of the termite excrement cemented together by the insect and plastered over the wood fibres. There are irregular chambers of varying sizes, and the whole nest presents an appearance rather like the fungus combs of a mound-building termite such as *Odontotermes obesus* but with the chambers more flattened. The central portion of the nest is rather more compact than the superficial parts, where the chambers are larger. No royal chamber could be found.

The West Bengal nest was about 30 cm. in maximum length, 15 cm. in maximum width, and 12.5 cm. in maximum height. It was found in a log of 'baen' 60 cm. long and 30 cm. in diameter lying on the ground; the log itself showed no external indication of damage inside. The railway carriage nest was about 40 cm. in length and 15 cm. in the large diameter.

For '*C. parvulus*' (which is a synonym of *C. heimi*, see above) Beeson, 1941, p. 544 wrote as follows: '*Coptotermes parvulus* makes a simple nest of small extent underground whence it tunnels into logs on the ground and ascends the trunks of trees in the bark in galleries covered in with earth.'

The only other observations on the nest of *C. heimi* are those of Annandale (1923, pp. 250-251) made on the Barkuda Island, Chilka Lake. The nests were found in the moist portions of logs and trunks of the banyan, *Ficus benghalensis*. Several nests may occur in a single log and are confined to those parts of it that remain damp. During the hot weather the insects retire to the heart of the trunk, but in the rains they may be found immediately under the bark. The nest-structure has a superficial resemblance to the spongy excretory and woody material (the 'fillings' of Assmuth, 1913) with which the termite fills the cavities it creates inside the wood it feeds on, but can be distinguished from the latter by its more fragile and papery structure. According to Annandale: 'The chambers in this nest are eaten out from the wood by little bodies of workers, which crowd together for the purpose and are apparently so intent on their work that they can be dissipated only by violence. As they eat away the wood they secrete some substance that dyes it black to a depth of about a millimetre. Possibly this substance may guide another body working independently from the other side of the partition, by means of some flavour or of a peculiar consistency it imparts to the wood. The excrement must be spread on the walls in a liquid or semi-liquid condition after they are completed. The flattened pellets can be distinguished by the naked eye.'

Assmuth (1913) stated that the workers of *C. heimi* spread their excrement on any body including glass surfaces, over which they crawl, and that this layer may form an easy pathway for the workers. Annandale (1923), however, was of the opinion that the real function of this layer of excrement is to strengthen the walls of the cells of the nest etc., for 'the partitions between the cells are often so fragile, especially where the wood is rotten, that they would collapse unless strengthened'.

In a nest opened in April, Annandale found some of the cells, always at a considerable distance from those occupied by living individuals, filled with the dead and shrivelled bodies of workers and soldiers. No particular royal chamber could be distinguished. The occupied cells always contain large numbers of soldiers and workers, including immature individuals.

Annandale further noticed that the nests of *Microcerotermes annandalei* seem to be precisely like those of *Coptotermes heimi*, and he considered it possible that the former species merely occupies deserted nests of the latter.

VII. SOME OTHER BIOLOGICAL DATA

1. Duration of life

From observations in the Barkuda Island (Chilka Lake), Annandale (1923, p. 237) concluded that in *Coptotermes heimi* the individuals in a colony die early and probably do not live beyond a year. He wrote : '... the sexual individuals of those species in which the winged adults are small live for a shorter period than those in which they are large, and, indeed, probably survive for only one year. I base this conclusion on the fact that in *Capritermes obtusus*, *Coptotermes heimi* and *Eurytermes assmuthi* only very young wingless males and females were found in nests examined shortly after swarming time. In all these species it is probable that more than one pair of adults inhabits each nest.'

For workers and soldiers, he stated : 'That many die off in the latter part of the dry season I have no doubt... In a nest of *Coptotermes heimi* opened in April I found many dead and shrivelled corpses of workers and soldiers in chambers somewhat remote from those occupied by living individuals.'

2. Proportion of the various Castes

The only observations are those of Roonwal (1954, p. 465) who stated that in Sillari, Madhya Pradesh, the soldiers constituted about 33 per cent of a soldier-worker population in a dead tree of 'salai', *Boswellia serrata*.

3. Ecological Adjustment with other Species of Termites

Coptotermes heimi seems to live in peaceful ecological adjustment with several other species of termites. Thus, on the Barkuda Is. (Chilka Lake) Annandale (1923, p. 250) found that in a dead trunk of the banyan tree, *Ficus benghalensis*, no less than five species of termite were living : *Odontotermes feae*, *Odontotermes obesus*, *Microcerotermes annandalei*, *Microtermes anandi*, and *Coptotermes heimi*. Similarly, in the Sillari forest in the Nagpur-Wardha Forest Division in the Bombay State (formerly in Madhya Pradesh) Roonwal (1954) found that in a recently dead standing tree of the 'salai', *Boswellia serrata* Roxb. (Fam. Burseraceae), two species, namely *Coptotermes heimi* and *Odontotermes redemanni* (Wasm.), were living. *O. redemanni* fed on the surface of the sapwood not going deeper than about one centimetre from the surface both on the bole and the root stock, while *C. heimi* was confined to the core of bole which it had completely hollowed out and filled with a hard spongy whitish excretory material.

4. Secretion of Whitish Fluid by Soldiers

The soldiers of *C. heimi* share with other members of the genus *Coptotermes* the habit of ejecting a whitish milky fluid in the form of a droplet from the opening of the fontanelle on the dorsum of the head. The fluid, which on exposure to air quickly hardens to a gummy solid, is secreted by a large gland which extends from the head into the abdomen.

VIII. SUMMARY

1. *Coptotermes heimi* (Wasmann) (Isoptera, Rhinotermitidae, Coptotermiinae) [synonym *C. parvulus* Holmgren] is one of the three termite species which are most destructive to timber in houses and elsewhere in India.

2. The available data on its biology and ecology are limited and widely scattered. In the present paper, while providing new biological data on swarming, nest-structure, host-material, etc., the existing data are summarised for ready use.

3. The nomenclative position of the species is briefly given, and *C. parvulus* Holmgren is regarded as a synonym of it. Some authors have, without justification, synonymised *C. heimi* (Wasm.) with *C. travians* (Haviland).

4. Geographical distribution. The species has been recorded from all over India and parts of W. Pakistan (W. Punjab). It does not occur in Ceylon.

5. Host-plants, etc. The species is polyphagous and feeds on dry constructional timber as well as on dead and semi-rotten wood, logs, and trunks of dead standing trees of a large number of host-plants. About 35 such species, belonging to a wide assortment of families, have been recorded. In addition, it has been recorded as damaging packing cases, wooden sleepers, papers, books, and woodwork in electrical installations, etc.

6. The economic importance of the species and the nature of damage it causes, i.e. its 'feeding pattern' in the wood, is discussed.

7. Swarming. Swarming occurs from March to August, at dusk or in the early part of the night. Statements of winter swarming (January and February) need confirmation.

8. Nests, etc. Nesting occurs in small colonies in logs of wood of several species (at least six such species have been recorded), in soil in the ground, and between the wooden boards of railway carriages. Several nests may occur in the same trunk. The nest made by the workers is a flat suboval structure, about 30 cm. in length and 15 cm. in the long diameter, composed of a network of narrow, flattened, suboval cells, constructed out of the wood left after eating, and with the walls plastered with termite excrement.

9. Some other biological data, such as the duration of life, the proportion of individuals of the various castes, ecological adjustments with other termite species, and the secretion by the soldiers of a whitish milky fluid from the dorsum of the head, are discussed.

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